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CONTENTS OF SERIES II, VOLUME 8

PAGE

Title page i

Contents iii

The Subsurface Stratigraphy of the Atlantic Coastal Plain. By HORACE G. RICHARDS 1

Cellular Mechanisms in Chemotherapy. By M. J. KOPAC 5

Problems in the Description of Personality. I. Sociability or Extroversion-Introversion. By ROBERT A. BROTEMARKLE 11

Primitive Medicine. By ERWIN H. ACKERKNECHT 26

Conference on "Amino Acid Analysis of Proteins" 38

New Members 39, 91, 170, 192, 218, 253

The Regional Structural Relations of the Ore Deposits of the Noranda District, Western Quebec. By MORLEY E. WILSON 43

Tempo and Mode in Evolution. By GEORGE GAYLORD SIMPSON 45

The Basic Psychology of Rumor. By GORDON W. ALLPORT and LEO J. POSTMAN 61

The Problem of Education in Contemporary China. By FRANCIS L. K. HSU. 82

Jurassic and Lower Cretaceous History of the Gulf Region. By RALPH W. IMLAY 93

The Relationship between Common Baldness and Male Sex Hormones. By JAMES B. HAMILTON 101

Conference on "Proteins and Protein Hydrolysates in Nutrition" 103

Report of the Annual Meeting. By EUNICE THOMAS MINER 104

Nutrition as a World Problem. By FRANK G. BOUDREAU 112

Nutrition as an Exact Science. By OTTO A. BESSEY 124

The Future of Nutritional Science. By CHARLES G. KING 125

Polyelectrons. By JOHN ARCHIBALD WHEELER. (Abstract) A. Cressy Morrison Prize Winner, 1945 131

The Limitations of Optical Image Formation. By MAX J. HERZBERGER. (Abstract) A. Cressy Morrison Prize Winner, 1945 132

The Golgi Apparatus—an Interpretation of its Structure and Significance. By LEONARD G. WORLEY. (Abstract) A. Cressy Morrison Honorable Mention, 1945 133

Carcinogenesis and Cell Adaptations. By ROSCOE R. SPENCER 135

Ants and Men: Problems in the Bio-Psychology of Social Organization. By T. C. SCHNEIRLA (Title only) 138

PAGE

The Evolution of the Race Idea in Modern Western Culture during the Period of the Pre-Darwinian Nineteenth Century. By Earl W. Count. 139

Conference on "Antibiotics" 166

Announcement, A. Cressy Morrison Prize Contest, 1946 168

Problems of Cambrian Stratigraphy and Paleontology in Quebec. By Franco Rasetti 177

Recent Advances in Human Heredity. By Laurence H. Snyder 182

Research in Group Dynamics. By Kurt Lewin (Title only) 185

Experimental Anthropology. By Sherwood L. Washburn 186

Conference on "The Physico-Chemical Mechanism of Nerve Activity" 188

Conference on "Muscular Contraction" 190

Sand Dunes. By H. T. U. Smith 197

Virus Variation in Relation to the Cancer Problem. By F. Duran-Reynals. 200

Experimental Psychology and Ethics. By H. L. Hollingworth 202

Conference on "Physiological and Psychological Factors in Sex Behavior" 216

Conference on "The Relation of Diseases in the Lower Animals to Human Welfare" 217

Some Problems of Newfoundland Geology. By Alfred K. Snelgrove 221

Tissue Metabolism Studies on Bone Marrow. By Charles O. Warren 222

Psychosomatic Medicine. By Richard H. Hoffmann 229

Art and Its Function in the New Hebrides. By Paul S. Wingert (Title only). 233

The Folklore of a Small Town. By Carl Withers 234

Conference on "Some Aspects of Red Cell Production and Destruction" 252

Tertiary Land Bridges. By George Gaylord Simpson 255

Symposium on "The Place of the Standard Dog in Medical Research" 259

The Physiological and Biochemical Standardization of the Dog. By James B. Allison 260

Some Practical Aspects of Selecting and Maintaining Dogs for Medical Research. By Mark L. Morris 267

Electrical Measurements of Mental Activities in Man. By Edmund Jacobson. 272

The Study of Cultural Patterns in European Nations. By Ruth Benedict ... 274

Conference on "Convection Patterns in the Atmosphere and Ocean" 280

Conference on "Folic Acid" 282

Q
11
N524

TRANSACTIONS
of
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SECTION OF GEOLOGY AND MINERALOGY

OCTOBER 1, 1945

DOCTOR HORACE G. RICHARDS, Associate Curator of Geology and Paleontology, Academy of Natural Sciences, Philadelphia, Pa.: *The Subsurface Stratigraphy of the Atlantic Coastal Plain.* (The lecture was illustrated by lantern slides.)

Since the beginning of the war, there has been a considerable increase in the number of wells drilled along the Atlantic Coastal Plain. This increase was caused by two factors: (1) the construction of many army camps, naval bases and industrial plants and the consequent need for additional supplies of ground water; and (2) the oil shortage and the increased search for new supplies.

With the aid of a grant from the Penrose Bequest of the Geological Society of America, the writer has undertaken a study of the samples from many of these wells, and has endeavored to correlate the subsurface formations.[1] While emphasis has been placed on the macrofossils, especially mollusks, all other available evidence has been considered, including the microfossils, lithology and a study of the literature. The region under consideration extends from New Jersey through Georgia

[1] **Richards, H. G.** Subsurface stratigraphy of Atlantic Coastal Plain between New Jersey and Georgia. Bull. Amer. Assoc. Petroleum Geol. **29:** 885–955. 1945.

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and, so far, samples from about 200 wells have been studied in more or less detail. The project is being continued.

So far, no productive oil wells have been drilled along the East Coast, north of Florida. The various dry holes drilled in this area have yielded considerable information on the subsurface and, while the evidence can not be said to be encouraging, nevertheless, the East Coast can not yet be written off as impossible.

A few of the more significant oil tests along the East Coast are listed here:

Approximate Location	*Company*	*Basement*	*Total Depth*	*Date*
Jacksons Mills, Ocean Co., N. J.	N. J. Oil & Gas Fields Co.; W. & K. Oil Co.	1336	5022	1921
Bridgeville, Sussex Co., Del.	Sussex Oil Co.; Sun Oil Co.	—	3010	1935
Salisbury, Wicomico Co., Md.	Ohio Oil Co.	5529	5563	1944–5
Berlin, Worcester Co., Md.	Socony Vacuum Oil Co.	7150	7168	1945
Meadows, Prince George Co., Md.	.....	1522?	1522	1918
Matthews, Matthews Co., Va.	Elkins Oil Co.	2307	2325	1929
Havelock, Craven Co., N.C.	Great Lakes Drilling Co.	2318	2318	1927
Morehead City, Cartaret Co., N.C.	Coastal Plains Oil Co. (Karsten)	4021	4044	1945
Cape Hatteras, Dare Co., N.C.	Standard Oil of N. J.	now drilling		
Conway, Horry Co., S.C.	Pioneer Oil Co.	1400	1429	1939
Summerville, Dorchester Co., S.C.	.....	2450?	2450	1921?
Savannah, Chatham Co., Ga.	Savannah Oil Co.	—	2130	1920
Offerman, Pierce Co., Ga.	Pan American	4355	4375	1938
Offerman, Pierce Co., Ga.	Donald Clark	4335	4355	1939
Albany, Daughtery Co., Ga.	J. R. Sealy, No. 1	—	5013	1942
Cedar Springs, Early Co., Ga.	Mont Warren *et al*-Chandler	—	7240	1943
Camilla, Matchell Co., Ga.	Stanolind Oil & Gas Co.	7474	7488	1944
McKinnon, Wayne Co., Ga.	California Co.	4575	4626	1944
Pearson, Atkinson Co., Ga.	Sun Oil Co.	4220	4283	1944

For more complete list of oil tests see Richards (*op. cit.*). The tests have been distributed along the Coastal Plain as follows:

New Jersey	9
Delaware	3
Maryland	5
Virginia	1
North Carolina	4
South Carolina	6
Georgia	30

Among the more significant results, may be mentioned the following:

1. Shell fragments and Foraminifera were found in wells at Asbury

Exch.
New York Academy of Sciences
1-46 46

Park, N. J., Fort Dix, N. J., and Freehold, N. J., in the Englishtown formation, from which no fossils have hitherto been reported.

2. Shell fragments and/or Foraminifera have been found in the Raritan formation at Fort Dix, N. J., Clementon, N. J., Bridgeville, Del., and Salisbury, Md. This formation is correlated with the Tuscaloosa.

3. The presence of Lower Cretaceous non-marine sediments is suggested from a well at Salem, N. J.

4. Jackson Eocene fossils were found in wells at Atlantic City, N. J., Brandywine Lighthouse, N. J., Bridgeville, Del., and Salisbury, Md. These mark the northernmost extension of the late Eocene.

5. Midway (Paleocene) fossils are reported from the subsurface in New Jersey (lower Hornerstown), Delaware, Maryland and Virginia.

6. The well at Salisbury, Md. showed a remarkable thickness of non-marine Lower Cretaceous (3000 feet). Preliminary studies show an even greater thickness at Berlin, Md.

7. At both Salisbury and Berlin, the Lower Cretaceous was underlain by rocks of probable Triassic age. Basement was struck at Salisbury at 5529 feet and at Berlin at 7150 feet.

8. Although the Eocene is very thin in Virginia, south of the James River, Lower (Midway), Middle (Pamunkey) and Upper (Jackson) fossils have been recognized.

9. Marine fossils assigned to the Tuscaloosa (Upper Cretaceous) have been found in wells at Norfolk, Va., Drivers, Va., and Franklin, Va. This formation does not outcrop in Virginia.

10. Middle Eocene (Pamunkey) fossils have been found in a well at Williamston, North Carolina. This is the first record of older Eocene from this State.

11. The Tuscaloosa, which is non-marine in outcrops in the Carolinas, contains marine fossils at Havelock, N. C., Morehead City, N. C., Conway, S. C., and Parris Island, S. C.

12. The well at Havelock, N. C., encountered granite at 2319 feet, while the Karsten well, near Morehead City, only 17 miles away, reached granite at 4021 feet. Havelock may represent the top of an ancient hill, while Morehead City may be the base. A similar hill in the basement is noted at Fountain, N. C., where the granite is exposed at the surface, whereas a mile or so to the east and west, it is buried 200 feet or more.

13. The Triassic has been reported from wells at Florence, S. C., and Summerville, S. C. However, no samples are available for study.

14. An exceptional thickness of marine Tuscaloosa is noted in the Sealy No. 1 well, near Albany, Ga. (2313 feet).

Descriptions and notes on the rare or new species of macrofossils are being prepared and will be submitted to the Journal of Paleontology.

SECTION OF BIOLOGY

OCTOBER 8, 1945

DOCTOR M. J. KOPAC, Assistant Professor of Biology, Washington Square College of Arts and Science, New York University, New York, N. Y.: *Cellular Mechanisms in Chemotherapy.* (This lecture was illustrated by lantern slides.)

The selective destruction of neoplastic cells by chemical compounds is more difficult than the control of invading microorganisms. One may expect sufficient biochemical differences between the host and parasite to make possible the destruction of the microorganisms without damaging host tissues. On the other hand, the differences between neoplastic cells and their normal ancestors are far more subtle and, in many cases, so slight as to make difficult the destruction of one cell type without seriously damaging the normal precursors.

Differences between neoplastic cells and their normal ancestors do exist. For example, Chambers, Cameron and Kopac[1] showed that lymphoid cells obtained from malignant tissues were more susceptible, in tissue cultures, to destruction by tetramethyl-o-phenylenediamine than were the lymphocytes obtained from normal lymph nodes. Cameron, Kensler and Chambers[2] demonstrated differences in reactivity to certain chemical compounds between other neoplastic cells and their normal prototypes.

The methods used in testing chemical compounds for oncolytic activity generally fall into two groups: (1) enteral or parenteral administration of the compound to animals with spontaneous or transplantable neoplasms, and (2) exposure of established tissue culture growths containing mixed populations of neoplastic and non-neoplastic cells to solutions of the compound. Hundreds of organic and inorganic compounds have been tested for oncolytic activity by many investigators, with the majority using the first method. The second method, however, gives more specific data on the action of a compound on the neoplastic cells.

Roffo[3] reported that hydrolysates of striated muscle inhibited the growth of certain rat and mouse neoplasms *in vivo* and *in vitro*. Boyland[4] localized the growth-inhibitory substances in the trichloracetic acid-soluble, phosphotungstic acid-insoluble fraction of mineral acid

extracts of muscle tissues. Such fractions would contain the amines, guanidines, and related nitrogenous bases.

The problem of neoplastic chemotherapy is considered from three points of view: (1) the nature of cytological changes produced by the action of those compounds that selectively destroy neoplastic cells without seriously damaging normal cells; (2) the determination of the action on secretory activity of kidney tubules, in tissue culture, of those compounds that destroy neoplastic cells; and (3) the determination of various physico-chemical properties of those compounds that destroy neoplastic cells and comparison with the properties of related compounds that do not destroy neoplastic cells.

A variety of organic compounds including ethylamines, diphenylethylamines, isothioureas, thioureas, aromatic diguanidines, and aromatic diamidines were tested on kidney tubules, in tissue culture.[5] The most interesting compounds, on the basis of their chemical structure and of their action on kidney tubules and on neoplastic cells, are the aromatic diamidines.[5, 6] In the kidney tubule preparations,[7] the action of the compounds can be tested simultaneously on secreting and non-secreting epithelia, connective tissue cells, wandering cells, and others. For example, the compound S-methylisothiourea, at certain concentrations, destroys all non-secreting structures, while the secreting structures continue to function almost normally. By comparison, N-methylthiourea, at the same concentrations, is non-toxic to both secreting and non-secreting components of the tissue culture preparation.[5]

The action of selected compounds on protein molecules, as well as on nucleoprotein systems, is being determined by surface-chemical methods. For the study of protein denaturation, the procedure is to expose protein molecules to interfacial forces in the presence of a given compound, at concentrations of the same order as those used in biological tests. Any incipient denaturating action of the agent will produce a significant increase in surface-denaturation of the protein and this can be measured by the surface-chemical methods employed (Kopac[8]).

Of the 6 aromatic diamidines tested, stilbamidine diisethionate, at concentrations not affecting normal tissues, showed a specific destructive action on the neoplastic cells of the rat mammary adenocarcinoma, R2426 (Eisen[9]), and of the transplantable lymphosarcoma of the rat (Murphy and Sturm[10]). The other diamidines, including phenamidine,

propamidine, and pentamidine, killed all normal and neoplastic cells at the higher concentrations and failed to destroy any of the cells at lower concentrations.[9]

Several effects were observed in the nuclei of the adenocarcinoma cells treated with stilbamidine. These changes include: irregularity in nuclear size and shape, increase in nuclear granules and blebs, and pyknosis. Stowell[11] reported similar changes in the nuclei of the R2426-tumor cells following treatment, *in vivo*, with 4000 roentgens of 200-kv x-radiation. Furthermore, stilbamidine blocks mitosis in neoplastic cells at concentrations that have no effect on the mitotic processes of normal or non-neoplastic cells.

Stilbamidine enhances the surface-denaturation of serum albumin to a considerable degree. The other diamidines do so slightly, or not at all. These results indicate that stilbamidine, more so than the other diamidines, can weaken or rupture certain structural linkages, presumably, the side chains held together by hydrogen bonds in the albumin molecule. These weakened linkages, when augmented by interfacial forces, produce a significant increase in surface denaturation.

The micro-surface-chemical methods[6]—simultaneous exposure of protein molecules to surface forces and the diamidine—therefore permit the measurement of incipient denaturation in protein molecules as produced by low concentrations of a denaturating agent.

A recent development[12] involves the action of stilbamidine, and other diamidines, on protamine-ribonucleates which represent simple models of the nucleoproteins. Stilbamidine diisethionate, at 0.002 M or less, produces an unfolding (denaturation) of the protamine molecule, as indicated by surface-chemical methods. Stilbamidine, at similar concentration levels, dissociates protamine-ribonucleate to release the protamine and simultaneously traps the ribonucleate by the formation of an insoluble stilbamidine-ribonucleate complex.

The surface-chemical methods are so employed that the degree of protamine-ribonucleate dissociation can be estimated by measuring the interfacial adsorption of liberated protamine at appropriate oil-water interfaces. The reactions include:

$$\underline{\text{Protamine-ribonucleate}} + n\ \underline{\text{Stilbamidine}} \rightarrow \underline{\text{Stilbamidine}_n\text{-ribonucleate}}\ \underline{\text{[insoluble complex]}}$$

$$\underline{\text{Protamine-ribonucleate}} \xrightarrow{\text{partial denaturation}} + \underline{\text{[Protamine]}} \longrightarrow \underline{\text{Increased interfacial adsorption.}}$$

The dissociation of protamine-ribonucleate results from the partial denaturation of protamine and possibly from the denaturation (alteration in configuration) of ribonucleic acid. Nucleoproteins, therefore, can be destroyed by low concentrations of stilbamidine.

Propamidine diisethionate, on the other hand, does not dissociate protamine-ribonucleate, nor does it produce any significant unfolding (denaturation) of the protamine molecule. However, it does form complexes with Na-ribonucleate, although these may be slightly more soluble than the stilbamidine-ribonucleates.

In all probability, the property of a compound to dissociate protamine-ribonucleate is dependent on its ability to denature the protein moiety.

The first toxic, intracellular action of stilbamidine appears to be the dissociation of protamine-ribonucleate complexes. Stilbamidine thereby releases partially denatured protamine and simultaneously binds the nucleic acids. Destruction of certain nucleoproteins, *per se*, may be sufficient to kill the cell.

The second toxic reaction follows the liberated and partially denatured protamine molecules. These protamine molecules, situated intracellularly, can now react by salt linkages with a variety of phosphorylated compounds including: adenosine di- and tri-phosphates, diphosphopyridine nucleotide, phosphocreatine, diphosphothiamine, and the phospholipids. Many of these substances may be temporarily or permanently inactivated depending on the nature of the complexes, *e.g.*, solubilities and dissociation constants. Although stilbamidine can interact directly with the phosphorylated compounds, there is some evidence to indicate that the resulting complexes are less stable and more soluble than are those formed with ribonucleic acids.

Propamidine diisethionate does not dissociate protamine-ribonucleates and, accordingly, this substance cannot destroy nucleoproteins nor can it release partially denatured protamine. Propamidine may, however, inactivate some of the phosphorylated compounds by forming complexes with them. In this way, the toxic nature of propamidine becomes evident, although this agent lacks the specificity shown by stilbamidine.

Differences in nucleoprotein content, between neoplastic cells and their normal ancestors, both quantitative and qualitative, have been

described by several investigators, especially by Stowell,[13] and Stowell and Cooper.[14]

One may likewise expect considerable variation in physico-chemical properties of these nucleoproteins. Accordingly, it should be possible to dissociate certain nucleoproteins without damaging others. Such a task would require the synthesis of compounds possessing the necessary specificity to denature the protein moiety and thereby dissociate the desired nucleoprotein components of a given cell.

The specificity shown by stilbamidine in destroying certain neoplastic cells may be interpreted in two ways: (1) that this diamidine is sufficiently specific to dissociate those nucleoproteins essential to the neoplastic cells, or (2) that neoplastic cells contain nucleoproteins more readily dissociated by stilbamidine, than are those present in normal cells.[12]

Propamidine, on the other hand, does not denature protamine and thereby lacks the ability to dissociate similar nucleoproteins. One should recall that, with stilbamidine, the nucleoprotein complexes can be broken, while stilbamidine itself becomes bound by the liberated nucleic acids. The released protamine, in turn, provides the additional toxic factor by binding essential phosphorylated and other acidic metabolic intermediates. Propamidine, instead, reacts directly with the acidic substances and, if its intracellular concentration becomes high enough, it functions as a general protoplasmic poison.

The key to specificity, therefore, lies in the dissociation of certain nucleoproteins. Not only can the latter be destroyed by appropriate substances but the activated or denatured protamine molecules, the dissociation products, are toxic.

It is hoped that the various data outlined herein may provide the necessary physico-chemical methods for evaluating the potential chemotherapeutic effectiveness of new compounds as they become available. Several of these are now being synthesized.

It seems clear, at present, that any compound, to be capable of destroying neoplastic cells selectively, must first have the property of dissociating certain key nucleoproteins. The dissociating potency of such compounds should be of the same order as that demonstrated by stilbamidine on simple protamine-ribonucleates.[12]

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SECTION OF PSYCHOLOGY

October 15, 1945

Doctor Robert A. Brotemarkle, Director of Psychological Laboratory and Clinic, University of Pennsylvania, Philadelphia, Pa.: *Problems in the Description of Personality. I. Sociability or "Extroversion-Introversion."* (The lecture was illustrated by lantern slides.)

The long history of man's attempts at the description of personality is well-known. In this paper, some problems in the description of personality are presented, which have been high-lighted anew for us by the most recent findings in the excellent studies by Raymond B. Cattell in his article on the "Principal Trait Clusters for Describing Personality."[1] In the review of his findings Cattell remarks: "In closing, it is relevant to point to the possibilities by some entirely free speculation. Once the data are preserved in the above index system against the sclerosis of premature verbal coinage and the insidious assault of implicit interpretation, freer discussion may safely be indulged in 'out of court.' One can note that a majority of the clusters established by correlation procedures seem to be actually well known syndromes of the clinic and the laboratory."

It is my desire to investigate with you some of the problems to be observed in these syndrome relationships, which prompts me to run the risk of considerable "implicit interpretation." However, since we cannot presume upon undue familiarity with the more recent and extensive findings of Cattell, I shall of necessity have to place before you something of the entire picture of his work, before turning to my study of the particular area of our discussion.

Cattell, in "The Description of Personality: Basic Traits Resolved into Clusters,"[2] adopted an approach which must be satisfactory to most of us when he states, "The position we shall adopt is a very direct one, verging on a pragmatic philosophy, and making only the one assumption that all aspects of human personality which are, or have been, of importance, interest, or utility have already become recorded in the substance of language."

[1] Psych. Bull. 42 (3): 129–161. 1945.
[2] J. Abnormal & Soc. Psych. 38 (4): 476–506. 1943.

Proceeding to the selection of a "categorized trait list," based upon the study of previous collected lists and certain known syndrome elements, Cattell listed 171 dichotomous or opposite pairs of traits in his "Final Population of the Trait Sphere."[3] From these traits, his extensive correlation studies resolved a series of "clusters" falling under certain "sectors" in the total personality "sphere." It should be noted that each trait-pair includes a number of trait terms which some might consider synonymous, or as giving expression to modifications or variations of the trait dichotomy.

At this point, it is important for us to have before us the briefly described "clusters" in their relationship to the "sectors" and the total "sphere," and likewise the commonly known syndrome or experimentally determined patterns related thereto.

In presenting Cattell's "Sphere of Personality,"[2] let us assume that each of us is standing in the center of the "sphere" and from this point of vision we will have coming to us the lines representing the various "sectors," "clusters" and trait-pairs, and we shall find innumerable lines of reference or relationship passing through us as they establish the numerous cross-relationships between the various "clusters."

THE SPHERE OF PERSONALITY

By Raymond B. Cattell

Region A

Character. Personality Integration
vs
Moral Character Defect. Neurosis, Psychosis

SECTOR AA
Fineness of Character
vs
Moral Defect, Non-persistence

CLUSTER AA1
Integrity, Altruism — "psychopathic personality" (constitutional character) RAB*
vs
Dishonesty, Undependability

AA2
Conscientious Effort — (mental character)
vs
Quitting, Incoherence

SECTOR AB
Realism, Emotional Integration
vs
Neuroticism, Evasion, Infantilism

* This, and the succeeding "interpretative statements are added by the author of this article. [Ed.]

CLUSTER AB1	
Realism, Reliability	"pre-psychotic simple schizophrenia"
vs	
Neuroticism, Changeability	
CLUSTER AB2	
Practicalness, Determination	"pre-psychotic simple schizophrenia"
vs	
Daydreaming, Evasiveness	
CLUSTER AB3	
Neuroticism, Self-deception, Emotional Intemperateness	"general neuroticism"
vs	
CLUSTER AB4	
Infantile, Demanding, Self-centeredness	"conversion hysteria"
vs	
Emotional Maturity, Frustration Tolerance	
SECTOR AC	
Balance, Frankness, Optimism	
vs	
Melancholy, Agitation	
CLUSTER AC1	
Agitation, Melancholy, Obstinacy	"constitutional agitated melancholia"
vs	
Placidity, Social Interest	
CLUSTER AC2	
Balance, Frankness, Sportsmanship	"pre-psychotic catatonic schizophrenia"
vs	
Pessimism, Secretiveness, Inordinateness	
SECTOR B	
Intelligence, Disciplined Mind, Independence	
vs	
Foolish, Undependable, Unreflectiveness	
CLUSTER B1	
Emotional Maturity, Clarity of Mind	"emotional maturity" (emotional toned)
vs	
Infantilism, Dependence	
CLUSTER B2	
Gentlemanly, Disciplined, Thoughtfulness	(social toned)
vs	
Extraverted, Foolish, Lack of Will	
CLUSTER B3	
Creativity, Self-determination, Intelligence	(volitional toned)
vs	
Narrowness of Interests, Fogginess	
CLUSTER B4	
Intelligence, Penetration, General Talent	"g"
vs	
Lack of "g"	

Region C

Self-assertion, Venturesomeness, Clamourousness
vs
General inhibition, Modesty, Timidity

SECTOR CA
Egoism, Assertion, Stubbornness
vs
Modesty, Self-effacement, Adaptability

CLUSTER CA1
Crude social assertion, Exhibitionism — "inferiority over-compensation"
vs
Modesty, Obedience to Authority

CLUSTER CA2
Stubbornness, Pugnacity, Clamourousness — "assertive-submissive"
vs
Tolerance, Self-effacement

CLUSTER CA3
Rigidity, Despotism, Egotism
vs
Adaptability, Friendliness, Tactfulness — "assertive-submissive"

CLUSTER CA4
Shrewd, Dictatorialness — "assertive-submissive"
vs
Naive, Unassertiveness

CLUSTER CA5
Assertion, Rivalry, Conceit — "assertive-submissive"
vs
Modesty, Unassumingness

CLUSTER CA6
Eager, Self-assertion — "assertive-submissive"
vs
Lack of Ambition

SECTOR CB
Boldness, Independence, Toughness
vs
Timidity, Inhibition, Sensitivity

CLUSTER CB1
Energy, Boldness, Spiritedness — "somatotonic"
vs
Apathy, Timidity, Langour

CLUSTER CB2
Independence, Cleverness, Confidence — "somatotonic"
vs
Timidity, Dependence, Languidness

CLUSTER CB3
Lack of restraint, Adventurousness — "general inhibition"
vs
General inhibition, Fearlessness

CLUSTER CB4	
Poised sociability, Inertia, Toughness	"hyper-thyroid hypersensitivity"
VS	
Introspectiveness, Sensitivity, Haste	
CLUSTER CB5	
Smartness, Assertiveness, Independence	
VS	
Unsophistication, Submissiveness, Reverence	
SECTOR D	
Sociability	
VS	
Timidity, Hostility, Gloominess	
CLUSTER D1	
Sociability, Adventurousness, Heartiness	"extrovert-introvert" (general sociability)
VS	
Shyness, Timidity, Reserve	
CLUSTER D2	
Sociability, Sentimentalism, Warmth	"extrovert-introvert" (general social interest)
VS	
Independence, Hostility, Aloofness	
CLUSTER D3	
Interest in group life, Liking to participate	"extrovert-introvert" (social group interest)
VS	
Self-sufficiency	
CLUSTER D4	
Personal attractiveness, Sociability, Pleasure seeking, Frivolity	"extrovert-introvert" (socio-personal reactions)
VS	
Earnestness, Asceticism, Mirthlessness	
CLUSTER D5	
Cheerful, Enthusiastic, Witty	"extrovert-introvert" (socio-evaluation reactions)
VS	
Cold-hearted, Sour, Mirthless	
SECTOR E	
General emotionality, High-strungness, Instability	
VS	
Placidity, Deliberateness, Reserve	
CLUSTER E1	
High-strungness, Impulsiveness, Anxiety	"hypomania"
VS	
Apathy, Relaxation, Deliberateness	
CLUSTER E2	
Sthenic emotionality, Hypomania, Instability	"hypomania"
VS	
Self-control, Patience, Phlegm	

CLUSTER E3
Intrusiveness, Frivolity, Neuroticism, Instability — "pre-psychotic hebephrenic schizophrenia"
vs
Deliberateness, Seriousness, Reserve

CLUSTER E4
General emotionality, Dissatisfied, Intense — "general emotionality" "physiological and constitutional"
vs
Content, Placid, Temperate

SECTOR F
Gratefulness, Friendliness, Idealism
vs
Sadism, Slanderousness, Suspiciousness
(Benign Cyclothyme vs Hostile Schizothyme)

CLUSTER F1
Gratefulness, Easygoingness, Geniality
vs
Hardness, Vindictiveness, Cold-heartedness

CLUSTER F2
Gratefulness, Kindness, Christian Idealism
vs
Hostility, Cynicism, Selfish-withdrawal

CLUSTER F3
Friendliness, Generosity, Cooperativeness — "obsessional compulsive"
vs
Hostility, Meanness, Obstructiveness

CLUSTER F4
Cynicism, Suspicion, Dishonesty — "paranoid personality"
vs
Idealism, Trustfulness, Respecting Self and Others

CLUSTER F5
Obstructionism, Cynicism, Unstable hostility
vs
Idealism, Affection, Sensitive consideration

CLUSTER F6
Benign emotional maturity — "emotional maturity"
vs
Slanderous, Jealous, Self-pitying, Infantilism

CLUSTER F7
Sadistic, Vindictiveness, Suspicion — "paranoid personality"
vs
Temper, Unresentfulness, Complaisance
(Paranoid schizoid vs Trusting cyclothyme)

SECTOR G
Liveliness, Insatiability, Verbal Expressiveness
vs
Reserve, Quiescence, Naturalness

CLUSTER G1
Austerity, Thoughtfulness, Stability
vs
Playfulness, Changeability, Foolishness

CLUSTER G2
Verbal Skill, Interesting ideas, Inquisitive
vs
Narrow interests, Absence of Flattery
CLUSTER G3
Eloquence, Affectedness, Conversationalism
vs
Self-effacement, Inarticulateness, Naturalness
CLUSTER G4
Creativity, Wit, Emotional color
vs
Dullness, Banality, Stability

SECTOR H
Imaginative intuition, Curiosity, Carelessness
vs
Thrift, Inflexible Habits, Smugness
CLUSTER H1
Thrift, Tidiness, Obstinacy "anal eroticism"
vs
Lability, Curiosity, Intuition
CLUSTER H2
Creativity, Curiosity, Intuition
vs
Stability, Insensitiveness

SECTOR I
Bohemian, Disorderly
vs
Persevering, Pedantic
CLUSTER I1
Profligacy, Planlessness, Friendliness
vs
Austerity, Hostility, Perseverance

SECTOR J
Aesthetic interests, Thoughtfulness,
Constructiveness
vs

CLUSTER J1
General aesthetic interests, Thoughtfulness,
Constructiveness
vs

SECTOR K
CLUSTER K1
Physical strength, Endurance, Courage
vs
Physical inactivity, Avoidance of danger

SECTOR L
CLUSTER L1
Amorousness, Playfulness
vs
Propriety

SECTOR M
CLUSTER M1
Alcoholism, Rebelliousness, Carelessness
vs
Piety, Reverence, Thrift

SECTOR N
CLUSTER N1

Curiosity, Wide interests
vs
Limited Interests
SECTOR O
CLUSTER O1
Hypochondriacal, Taciturn, Retroversion
vs
Eloquence, Interest in future
SECTOR P
CLUSTER P1
Asceticism, Eccentricity "hermit-eccentric schizophrenia"
vs
Comfort-loving conventionality
SECTOR Q
CLUSTER Q1
Inflexibility, Wandering
vs
Adaptableness, Ease of settling down

In addition to quoting the relationships which Cattell has stated, you will note the necessity of my having added certain interpretative statements to enable our further discussion of certain clusters and traits.

In approaching the work here so briefly described, Cattell has said, "A few such aspects of personality as extraversion, character integration, general emotionality, and various psychotic and neurotic syndromes exist in clinical observation, but they float freely in relation to each other and in an uncharted universe of large possibilities. For alone they contribute very little to the total definition of personality. The problem of primary importance at the outset of systematic factor analysis of personality, therefore, is to find means of choosing so complete a universe of traits that (1) no possible trait will escape detection, and (2) the inter-relations of all important constellations will be given by the analysis."

Feeling that Cattell has, without question, gone far toward the consummation of the task he set for himself, we recognize one cannot possibly study the in-relations of the entire sphere of personality at one time. It is our desire to study together one sector and its clusters. We have chosen the area of Sociability and the commonly related syndrome known as "extraversion-introversion."

We have chosen this area, first, because of its great importance in the organization of human personality, and secondly, because we sense the tremendous confusion which arises from its description in our every-day clinical and consulting activity. Can the study of Cattell's findings in this area help us in our own clinical and consulting descrip-

tion of personality? Certain commonplace observations about the area will enable us to enter into Cattell's findings more readily.

First, the "man in the street" makes clear to us certain facts about the description of Sociability. Ask him to describe for you the personality of a friend, and the chances are tremendous that his first statements will attempt to describe the social patterns of the individual's life, which may be stated very simply as "how he gets along with other people." Any lengthy description on his part or through persistent urging or questioning on yours will result in the "man in the street" telling you "how he gets along with other people" in terms of affective or emotional patterns, or "how he feels"; intellectual or mental patterns, or "how he thinks;" and motor or physical patterns, or "how he does things." And in all probability in this order or sequence.

We are facing here the fact that the area of sociability is a specific area of personality in which the descriptive language used reveals how an individual uses the other areas or factors of human behavior to respond to the specific stimulus of other persons, to that stimulus which man has long recognized as the most important in his environment and which has, therefore, been elevated to a "sector" or specific area of personality itself.

Second, the physiologist and others interested in the biophysical organism, in, and through which the human personality is given expression, have made clear to us that all structures and functions of the biophysical organism are required to explain the reactions and patterns of human behavior usually subsumed under the affective, the mental, and the motor areas of human personality. Some have given emphasis to the developmental unfolding through their discussions of the biophysical organism related to each area, and the possibility of dominating emphasis of certain areas in the total pattern of personality.

We are here facing the fact that there is no specific part of the biophysical organism set aside for the specific function of Sociability as such, but that, again, Sociability is the pattern of response established by each of these three areas in reaction to a specific stimulus of another or other individuals.

Third, the psychological clinician, in attempting the development of psychometric techniques to investigate Sociability in terms of Social Maturation has given emphasis to the same fact. Doll, in the "Vine-

land Social Maturity Scale,"[3] uses a large series of questions, each taken directly from the pattern of affective, mental or motor behavior, but seeks to find in what manner this specific behavior affects the pattern of the individual's response in the social situations or environment. It is not only important to know whether a child eats with his fork and knife; the greater problem of Sociability is whether others in the social group, the family, must disrupt their individual or social reactions to feed him, or whether he uses the eating tools himself and in accordance with patterns acceptable to the social group, and thus causes no disturbance to the family group activity. He may learn to read and to write, but the greater question in Sociability is whether he uses this accomplishment to attain the necessary interchange in communication of ideas to take his place in the social group without failure or disturbance.

The remaining emphases in the study of Sociability have had to do with the learning of patterns of reaction, their organization, their function, and the dynamic aspects of their inter-play in social living.

With these facts in mind, let us turn to the analysis of sector D—Sociability, and its clusters and traits as revealed by Cattell's findings.

It will be observed that the Sociability Sector makes use of 24 trait-pairs, or 14% of the total list of 171 trait-pairs. This might seem to contradict the significant fact that the Sociability Sector could employ all of the traits of human behavior in a specific way. On the other hand, it might reveal the fact that, in our desire to describe this area, we have narrowed it quite significantly. What is this descriptive pattern recorded in Cattell's findings and in the related syndromes of the clinic and laboratory?

First, we must observe that there are five, more or less, specific clusters subsumed under this sector, all of which are commonly referred to under the syndrome "extroversion-introversion." Our first necessity is to clarify the differences which may be found in the five clusters. To analyze the trait-pairs found under each cluster it seems necessary to designate them for the moment as follows:

SECTOR D—SOCIABILITY
- CLUSTER D1—General Sociability
- CLUSTER D2—General Social Interests
- CLUSTER D3—Social Group Interests
- CLUSTER D4—Socio-Personal Reaction
- CLUSTER D5—Socio-Evaluation Reaction

[3] Doll, Edgar A. Vineland social maturity scale. Vineland Training School. Vineland, N. J. 1935.

Some considerable difference accrues from the description of the Sociability of an individual in terms of D1—a general over-all sociability, or D2—a general interest in social actions, or D3—an interest primarily in specific social group actions, or D4—an emphasis upon the retroflex action of social life upon the temperament of the individual himself, or D5—an emphasis upon the retroflex action of social life upon the individual in terms of an evaluation made by the other members of the social group and in terms of their acceptance or rejection of certain standards of conduct.

This would likewise indicate the same considerable difference in the various patterns of the related parallel or synonymous syndrome of "extroversion-introversion," and in somewhat similar terms. The pattern of "extroversion-introversion" might be described as D1—a general over-all sociability, or D2—a general interest in social actions, or D3—an interest primarily in specific social group actions, or D4—an emphasis upon the retroflex actions of social life upon the temperament of the individual himself, or D5—an emphasis upon the retroflex action of the social life upon the individual in terms of an evaluation made by the other members of the social group and in terms of their acceptance or rejection of certain standards of conduct.

The analytical chart of D Sector's five clusters will enable us to see more readily what trait-pairs are specific or common to each cluster, and what such finding may mean to us.

Cluster D1 is composed of trait-pairs 95, 130, 149, 162, and 150, giving emphasis to the General Sociability of the individual. No single trait-pair is specific to this cluster. It has trait-pairs common to clusters D2, D3 and D4, particularly those involving 150—Seclusiveness-Gregariousness, and 95—General Social Interest. Other traits are shared with clusters under entirely different sectors of personality which will be discussed later.

Cluster D2 has three trait-pairs, numbers 14, 90, and 143, specific to itself and giving emphasis to interest in home and family group activity in an affective or sentimental way. D2 shares its emphasis upon 95—general interest in social life—along with D1, 132—Responsiveness-Aloofness—with D3; and an emphasis on 83—Dependence-Independence—with D3. One of these and other traits are shared with other clusters under entirely different sectors of personality.

Cluster D3 has no trait-pairs specific to itself. It shares the trait

CHART 1
ANALYTICAL CHART OF SECTOR D—SOCIABILITY (CATTELL)

Trait List Number	Trait Pairs	D Clusters	Related Clusters
14	Affectionate-Frigid	D2	
90	Interest in Home and Family	D2	
143	Sentimental-Hard-hearted	D2	
114	Optimistic-Pessimistic	D5	
95	Interest in Social	D1D2	
132	Responsive-Aloof	D2D3	
104	Laughterful-Mirthless	D4D5	
66	Frank-Secretive	D2	AC2
69	Genial-Cold-hearted	D2	F1
23	Ascetic-Sensuous	D4	P1
92	Interest in Physical Activity	D4	K1
169	Witty-Humorous	D5	G4
130	Reserved-Intrusive	D1	E3,G1
149	Shy-Sociable I (Forward)	D1	CB3,CB4
162	Bold-Timid	D1	CB1,CB3
142	Sensitive-Tough	D2	AC1,CB4
40	Cooperative-Obstructive	D3	F3,F5
109	Mischievous-	D4	G1,L1
144	Serious-Frivolous	D4	E3,G1
57	Enthusiastic-Apathetic	D5	CB1,E4
67	Friendly-Hostile	D2	CA3,F2,F3,I1
83	Dependent-Independent	D2D3	B1,B3,CB1,CB2,CB5
31	Cheerful-Gloomy	D4D5	AB3,AC1
150	Seclusive-Sociable II (Gregarious)	D1 D3D4	AC1

132—Responsiveness-Aloofness—with D2; 83—Dependence-Independence—with D2; and 150—Seclusiveness-Gregariousness—with D1 and D5. Some of these and other traits are shared with a number of clusters under entirely different sectors of personality.

Cluster D4 has no trait-pairs specific to itself. It shares trait-pair 104—Laughterful-Mirthless—with D5; and 31—Cheerful-Gloomy—with D4. Some of these and other trait-pairs are shared with clusters under entirely different sectors of personality.

Cluster D5 has specific to itself trait-pair 114—Optimistic-Pessimistic. It shares 104—Laughterful-Mirthless—with D4. All other trait-pairs are shared with other D clusters, as 31—Cheerful-Gloomy—with D4, and, at the same time, with a number of clusters under entirely different sectors of personality.

By now, we must be convinced of the scarcity of traits definitive of specific aspects of sociability or "extroversion-introversion." I am

fully appreciative of the fact that I am not clarifying the descriptions by this detailed analysis. For the time, I am asking you merely to observe the relationships involved.

When we turn to the trait-pairs shared by the five Sociability clusters with other clusters under entirely different sectors of personality, we shall observe the added confusion in syndrome description of personality.

Cluster D1—General Sociability—shares its very basic trait-pair 130—Reserved-Intrusive—with E3—"prepsychotic hebephrenic schizophrenia" and G1—stability of a thoughtful type; its most basic trait-pair 149—Shy-Forward—with CB3—"general inhibition" and CB4—"hyper-thyroid hypersensitivity"; 162—Bold-Timid—with CB1 "somatotonic" and CB3 "general inhibition"; and 150—Seclusive-Gregarious—with AC1 "constitutional agitated melancholia."

Cluster D2—General Social Interests—shares 66—Frank-Secretive—with AC2 "prepsychotic catatonic schizophrenia"; 69—Genial-Cold-hearted—with F1—a pattern of Gratefulness and Geniality; 142—Sensitive-Tough—with AC1 "constitutional agitated melancholia" and CB4 "hyper-thyroid hypersensitivity"; 67—Hostile-Friendly—with CA3 "assertiveness-submissiveness," F2—idealistic gratefulness, F3 "obsessional compulsiveness" and I1—a pattern of Bohemian Disorderliness; and 83—Independence-Dependence—with B1—the emotionally toned pattern of "emotional maturity," B3—the volitionally toned pattern of "emotional maturity," CB1 "somatotonic," CB2 "somatotonic," and CB5—a pattern of sophisticated behavior.

Cluster D3—Social Group Interests—shares 40—Cooperative-obstructive—with F3 "obsessional compulsive," and F5—a pattern of affectionate idealistic behavior; 83—Dependence-Independence—with B1—emotionally toned "emotional maturity," B3—volitionally toned "emotional maturity," CB1 "somatonic," CB2 "somatotonic," and CB5—a pattern of sophisticated behavior; and 150—Seclusiveness-Gregariousness—with AC1 "constitutional agitated melancholia."

Cluster D4—Socio-Personal Reactions—shares 23—Ascetic-Sensuous (comfort loving) with P1—a pattern of ascetic behavior; 92—Interest in Physical Activity—with K1—a pattern of physical activity and endurance; 109—Mischievousness—with G1—stability of a thoughtful type, and L1—a pattern of propriety; 144—Seriousness-Frivolousness—with G1—stability of a thoughtful type, and E3 "pre-

psychotic hebephrenic schizophrenia"; 31—Cheerful-Gloomy—with AB3 "general neuroticism," and AC1 "agitated constitutional melancholia"; and 150—Seclusiveness-Gregariousness—with AC1 "agitated constitutional melancholia."

Cluster D5—Socio-Evaluation Reactions—shares 169—Witty-Humorous—with G4—a pattern of creative stability; 57—Enthusiastic-Apathetic—with CB1 "somatotonic," and E4 "general emotionality" of a constitutional and physiological type; and 31—Cheerful-Gloomy—with AB3 "general neuroticism and AC1 "constitutional agitated melancholia."

The overlap of syndromes in use of certain trait-pairs may be observed as follows:

Cluster	*Syndrome* related by *number of trait-pairs*	
AB3	"general neuroticism"	1
AC1	"constitutional agitated melancholia"	3
AC2	"pre-psychotic catatonic schizophrenia"	1
B1	"emotional maturity" (emotionally toned)	1
B3	"emotional maturity" (volitionally toned)	1
CA3	"assertive-submissive"	1
CB1	"somatotonic" (1)	3
CB2	"somatotonic" (2)	1
CB3	"general inhibition"	2
CB4	"hyper-thyroid hypersensitivity"	2
CB5	(pattern of sophisticated behavior)	1
E3	"prepsychotic hebephrenic schizophrenia"	2
E4	"general emotionality"	1
F1	(pattern of grateful geniality)	1
F2	(pattern of grateful idealism)	1
F3	"obsessional compulsive"	2
F5	(pattern of affectionate idealism)	1
G1	(pattern of thoughtful stability)	3
G4	(pattern of creative stability)	1
I1	(pattern of bohemian disorderliness)	1
K1	(pattern of physical endurance)	1
L1	(pattern of propriety)	1
P1	(pattern of asceticism)	1

Of the 24 trait-pairs found under the five D-Sociability clusters, 7 are specific to D clusters alone or in combinations, while 17 are shared with a total of 23 other clusters or syndrome patterns of known observable personality reactions.

Let us assume that we are observing the behavior of an individual which we might describe as falling under the trait-pairs 150—Seclusive-Gregarious, 31—Gloomy-Cheerful, and 142—Tough-Sensitive. We would note that, in combination with certain other trait-pairs, we might readily refer the behavior to one or two clusters of 4 possible

clusters under D—Sociability, either D1, D2, D3, or D4; or observed with certain other trait-pairs we might refer the behavior to the cluster AC1—"Constitutional agitated melancholia." It must be clear to us that, even under the cluster AC1—"Constitutional agitated melancholia," we are observing one of 4 possible forms of Sociability reaction now recognized and reported. It is quite possible that there are other specific Sociability clusters not yet recognized to which this series of trait-pairs might also readily refer.

Such cross-relationships would be observed among the 23 clusters and the 5 D-clusters, if we should take time to carry out all possible combinations of personality reactions.

Our present analysis, I trust, must somehow force upon us the conviction that the clinician, or consultant, is seldom so thorough in the basic description of behavior reactions. At the same time, it must convict us of our own carelessness when confusion arises in the syndrome description of personality patterns.

Cattell has pointed to the possibility of more exact studies based upon experimental research under this method of more precise description of personality. The clinician and consultant should likewise be able to profit greatly in his analytical diagnosis under this form of more precise description of personality. It would repay the clinician and consultant to spend the time necessary to thoroughly familiarize himself with the findings now available through the analysis of Cattell's studies and the related phenomenological studies. The clinician and consultant must also face the challenge to make his much-needed contributions in the more accurate clinical description of personality, which are long awaited and necessary to the final solution of this gigantic task.

SECTION OF ANTHROPOLOGY

October 22, 1945

Doctor Erwin H. Ackerknecht, American Museum of Natural History, New York, N. Y.: *Primitive Medicine.*

One of the most important aspects of primitive medicine is the *pharmacopoeia* of most primitive tribes. Except for a very few regions, like the Arctic and Melanesia, where drug lore has been developed only slightly, an amazing percentage of the herbs, barks and roots used by the natives—a percentage which is far above the mathematical probability of random sampling—is of objective medicinal value.

Even today, our own pharmacopoeia is heavily indebted to the primitives. Picrotoxine, the powerful stimulant of the respiratory center; strophantine, the well known medicament in heart diseases; emetine, the alkaloid of ipecacuanha and specific in amebic dysentery—all are of Indian origin. Salicylic preparations for rheumatism were first used by the Hottentots, etc., etc. Yet our culture, which, somewhat prematurely, but all the more firmly, believes that the test tube is superior to the plant cells in synthesizing drugs, refuses, in general, to analyze the primitive material which anthropologists and missionaries have brought back from the field. A large scale analysis of primitive drugs would be of great practical importance to modern medicine.

All human societies, primitive and civilized, suffer from disease. Disease is much older than man. It is one of the fundamental, vital problems which face every society, and every known human society develops methods to deal with disease, and thus creates a medicine. But the attitude towards disease and the methods of fighting disease vary enormously in the different primitive tribes. Disease may be of extreme concern to a society, quite beyond its objective frequency. Anxieties arising from other sources may be projected into medicine. The Navahos are said to spend one-fourth to one-third of their productive time in religious ceremonials, most of which are concerned with disease. Disease and its healing or prevention plays a similar preponderant role in the religions of the Cuna, Chiricahua-Apache, Cherokee, Pima, and Liberian Manos. It is the main concern of the Pit River Indians of Northeastern California and, next after sex, of the

Yavapei. The attitude towards disease may take a strange twist, as in Dobu, where healing practices are subordinated to the all-absorbing problem of how, by appropriate spells, one can make one's neighbor sick! The attitude toward disease may change under our very eyes, as Redfield describes it for Yucatan, when acculturation occurs. Disease theories, diagnostic and therapeutic measures, all may vary widely. There may, or may not, be special medicine men. They may be poor or rich, all-powerful or uninfluential. Here, the magic power of the drug may be the central element of native medicine. There, the power of the healer or of the medical society.

We are accustomed to look at disease as a purely biological phenomenon, and at medicine as a kind of reflex reaction toward it. These differences in approach are therefore extremely disturbing to us, and all the more so as they are not founded primarily on the objective amount of disease in a given tribe. We may encounter various attitudes combined with about the same kind and amount of morbidity, and in very similar climatic and economic conditions. Under such circumstances, medicine has much more clearly the character of a function of the culture pattern than of the environmental conditions.

Though it is necessary to bear in mind these underlying variations, it is nevertheless possible to make a few generalizations concerning primitive medicine, especially with reference to some of their functional and psychological implications. I should like, however, to remind you of the following facts:

Disease and death among primitives are, for the most part, not explained by natural causes, but by the action of supernatural forces. In general, the disease mechanisms are either the intrusion of a disease-producing foreign body or spirit, or the loss of one of the souls which may be abducted or devoured. These mechanisms may be put into motion either by a supernatural agency (God, spirit, etc.) who feels offended, or by a fellow man who avenges himself either by hiring a sorcerer or by himself acting as a sorcerer. Supernatural causes must be discovered by supernatural means, and thus the primitive diagnosis consists of various types of divination—bone-throwing, crystal-gazing, trances, etc. The therapeutics cover a whole gamut of methods, reaching from purely matter-of-fact treatments (herbs, massage, bath, etc.), combined with magic spells or prayers, to purely magico-religious rites.

One of the common traits of primitive medicine, which makes it

rather different from ours, is the *social role* that disease and medicine assume in primitive society. Disease with us is, in the last analysis, a biological, individual, and non-moral problem. No guilt is involved when we suffer from hereditary, infectious, or degenerative diseases. Even in venereal diseases, we strive to eliminate the moral aspect as it has proved to be a handicap in their eradication. If you get appendicitis or cancer, you will never think of associating this with your behavior toward your neighbor or mother-in-law or your ancestral spirits. We do not usually associate disease with whether or not our personal relations are good, whether we keep certain religious or social rules or not. But this is exactly what the primitive does. Disease derived from sorcery, from taboo violation, from the anger of ancestral or other spirits is the expression of social tensions. A seemingly independent, biological problem is thus woven into the whole socio-religious fabric in such a way that disease and its healer play a tremendous social role, a role that, in our society, is assumed rather by judges, priests, soldiers, and policemen.

In many primitive societies, disease becomes the most important social sanction. Primitive medicine contains a moral element which is almost absent in ours. "Be peaceful, pay your debts, abstain from adultery, in order to protect yourself *and your family* from disease." It thus becomes possible to treat disease by pacifying offended persons. New light is here thrown on the marked interest of the primitive community in the diseased person and its participation in healing rites.

This social role of disease may also partly explain the persistency of primitive medicine, quite apart from its intrinsic medical value. The purely curative effect of certain rites may be negligible, but they are upheld because they fulfill important social functions.

In a way, disease, being thus regarded as a direct consequence of personal, social behaviour, makes more sense to primitive man than it can make to the patient in our society. Only rarely, are we able to relate the non-personal biological notions, which to us explain disease, directly to the actual life history of the patient. There is a tendency of the patient and his family in our society, well known to every medical practitioner, to bridge this gap, in constructing such relations even where they actually do not exist. You all might remember cases of cancer being referred to a slight and perfectly irrelevant bodily traumatism, cases of epilepsy explained by fright, etc. This tendency has

disappeared from medical science only gradually and at a relatively late period.

The social concept of disease in primitive society is also reflected in the belief that the disease sanction may affect every member of the family as well as the sinner himself. This is a far more inclusive notion than our concept of hereditary or infectious diseases. Therapeutic measures—whether it be confession or medication—have, therefore, very often to be applied not only to the patient, but to his whole family.

It is obvious how this specific social role, assumed by disease in primitive society, contributes to the formation of a type of medicine which differs considerably from the one to which we are accustomed.

I think it is safe to state, as a further general characteristic of primitive medicine, that it is *primarily magico-religious, utilizing a few rational elements;* while our medicine is predominantly rational and scientific, employing a few magic elements.* We are naturally inclined to think of primitive medicine in terms of rationality, just as primitives usually interpret our medicine in terms of magic. It is not difficult to see that both procedures are projections. One can, of course, argue that our medicine is magic, or that theirs is rational; but both statements need closer examination and qualification. I believe that I am more aware of magical elements in our medicine than many of my medical colleagues are. For the anthropologists, it is not difficult to discover the magic character that vitamins, germs, number complexes, etc. often assume in the mind of the *patient.* But one of the important strictures which have to be made is that *magic elements in our medicine are overwhelmingly on the side of the patient.* As far as our medical system and its representatives are concerned, they remain rational in intent, content and procedure. In order to obtain a clear picture, it is also necessary to look at the problem from a more quantitative angle, and I doubt whether anyone would seriously argue that the modern patient's approach to medicine and disease is *predominantly* magico-mystical.

Nobody will deny that, in a great number of primitive tribes, not all diseases are interpreted in a supernatural manner and that some are regarded as due to natural causes. This holds true, especially, for very common diseases, such as colds, toothache, malaria, etc., those resulting from old age, and those of which the imported character is

* I am using the term "rational" not as a mere equivalent of logical—magic is logical in its way too—but, as it is now commonly understood, logical on the basis of empirical premises.

clearly realized. Yet the inconsistency with which such ideas are used is noteworthy. The same disease might be naturally or supernaturally caused, and a natural disease might be treated supernaturally, or vice versa. It is also remarkable that positive knowledge concerning the "natural diseases" is about as poor as that concerning "supernatural diseases" and that primitive sceptics, in general, doubt the supernatural character of individuals or isolated events, but not the whole supernatural system.

There are a certain number of purely rational treatments, such as bleeding, massage, and drugs. Yet the number of such treatments decreases considerably after closer examination and appears at least to be "mixed." The rational character of the use of the tourniquet in snake bite among the Liberian Manos becomes, for instance, somewhat doubtful, when we hear that a ring of white clay might also be applied around the bitten limb. Rivers, observing an apparently rational abdominal massage for constipation, on Eddystone Island, was very disappointed in learning that it was destined to drive out a magic octopus. Another case in point is the Cherokee patient, who keeps a strict diet all day long, but devours everything at night when the taboo underlying his diet is no longer valid. The widespread division between medicine men and herbalists in primitive tribes has given rise to the premature conclusion that only the former are guided by supernatural ideas, while the latter are rationalists. This thesis seems to be unsupported by the facts.

The *fundamental error* in all this reasoning about primitive rationalism is the basic assumption that *what is objectively effective, is also rational and scientific.* Also, there are so many objectively effective elements in primitive magic treatments, such as, for example, drugs, baths, massage, sucking, bloodletting, isolating of infectious diseases, diet, inoculation against snake bite, etc., such treatments are without hesitation christened rational or even scientific, whereas they might be magical or purely habitual, almost automatic or reflex-like. Yet this identification of the objectively effective, the rational and the scientific can be nothing but a permanent source of confusion. The attribute of rational should be reserved for actions which are actually based on thought identifiable with our rational thinking. The notion of scientific should be handled with the same sense of discrimination. Even animals use objectively effective healing methods, while science has

nothing of an instinctive reaction. Linton has lately very justly written of science as an *invention*. One might as well speak of scientific thought as a great and late revolution in human behavior. Science aims primarily at truth, not at success or psychic relaxation. Science is unthinkable without a certain amount of individualism. It means a complete misunderstanding of scientific thought and methods, and of the whole history of science, to bestow the name of scientific, or even rational, upon practices which are, in general, uninfluenced by experience, free from scepticism, and where no numerical notions, no abstraction, no induction, and no systematization are underlying ideas. Calling every objectively effective procedure scientific seems to me to dilute the notion of science almost to complete meaninglessness.

This misunderstanding is also favored by the assumption that supernatural, irrational ideas and practices are always highly emotional. Thus, unemotional behavior ought to be rational. But experience with primitives shows that magic might be something highly unemotional.

I fully agree, therefore, with the following statement of the great American medical historian, Fielding H. Garrison:

> "If we are to understand the attitude of the primitive mind toward the diagnosis and treatment of disease, we must recognize that medicine, in our sense, was only one phase of a set of magic or mystic processes, designed to promote human well being, such as averting the wrath of angered gods or evil spirits, fire making, making rain, purifying streams or habitations, fertilizing soil, improving sexual potency or fecundity, preventing or removing blight of crops and epidemic diseases."

Isolated rational elements, the existence of which nobody denies, do not and are not able to change or even to influence considerably the fundamental character of this magico-religious system.

It is for pragmatic reasons that I have given so much importance to what might seem a quite superfluous discussion of terminology. Primitive medicine's contribution to our medical understanding consists, in addition to its great treasury of drugs, just in the fact that here we are able to observe a whole system of medicine, different from ours and yet functioning with considerable success. It is, perhaps, because of this difference, which seems to me greater than in other fields like religion, art, or law, that the study of primitive medicine has been rather neglected.

It is true that in merely calling primitive medicine, "magic," not much is accomplished. Limitations of space and time make it im-

possible for me to enter here a detailed discussion of magic. But I cannot abstain from alluding to the fact that, in my opinion, under the heading of magic, at least two very different sets of practices and beliefs have been lumped together.

I would like to mention here a few of the many effects which supernaturalism has on medical practice. The extreme *ignorance of anatomical facts* among primitives has often been commented upon, and has been attributed to the absence of dissections. Quite apart from the fact that experience in hunting, sacrifices, and cannibalism could well compensate for this shortcoming, I have been able to point to four areas in Siberia, Oceania, South America and West Africa where autopsies are practised quite extensively in order to discover whether the deceased died as the result of witchcraft or not. Yet these dissectors are just as ignorant of the most elementary anatomical facts as are their non-dissecting brethren. It is not a mere technique, but a complete change in outlook that almost brings about a change in perception and opens the eyes of the super-naturalist to anatomical facts.

There is, in general, satisfactory wound and fracture treatment among primitives, but almost nothing which resembles our *major surgery* (amputations, excisions of tumors, abdominal surgery). In the few places where such major surgery is practiced, it is mostly of very low quality. Here again, technical explanations are insufficient. Primitives certainly do not lack technical skill, as is shown by the widespread and successful performance of trepanation, an operation which had an extremely bad prognosis, even with western surgeons, until a few decades ago. Neither do primitives lack occasions to gain surgical experience, because of numerous accidents, ritual and judiciary mutilations occurring in primitive society. The greater resistance of those individuals who reach adult age in primitive societies, and the absence of particularly virulent bacterial strains as we cultivated them throughout centuries in our hospitals, would be a special asset for primitive surgeons. But the magic fear to appear mutilated in the spirit world is an all-powerful obstacle to the development of surgery. This fear creates opposition even to tooth extractions. For example, Linton says of the Tanala that they do not fear death, but mutilation. It is this supernatural character of mutilation which makes it so particularly an impressive form of punishment; and, in turn, people refuse amputation which would put them on the level of criminals.

Supernaturalism also makes for a strange *inflation of the pharmacopoeia,* where the effective and the ineffective are used without discrimination. This obvious lack of experimentation reduces claims of primitive rationalism that otherwise could find strong support in the primitive's use of effective drugs.

While supernaturalism, in general, serves as an obstacle to technical improvements in medicine, it sometimes brings them about as unintended by-products, as is shown by circumcision, certain forms of sex hygiene, and other sanitary measures. The most striking example of this kind is probably the invention of the *incubator for premature births* by certain Eskimos and Bantus. This invention seems to have arisen from particularly stringent taboos against miscarriage prevailing in these two tribes, otherwise so different from each other.

The irrational need not be ineffective, and with all its peculiarities, primitive medicine, which, by the way, in terms of space and time, covers a much larger field than does our scientific medicine, seems to have *served its purpose more or less satisfactorily.* In some places and periods, it seems to have been even superior to our medicine. Some of its successes (as are those of our medicine) are undoubtedly due to the fact that man is a fairly solid animal, and many diseases are self-limited anyway. The aforementioned objectively active elements in primitive medicine and its particular social mechanisms may account for other successes.

One particular character of primitive medicine, which is derived from primitive mentality, in general, and which makes description of primitive medicine on the basis of our categories so difficult, deserves special notice in this context. This is the *unitarian or total character of primitive medicine.* When, for practical reasons, for instance, we have spoken above of diagnosis and therapeutics, of bodily and mental diseases, we have done violence to the facts. Actually, there is no diagnosis separated from therapeutics in such acts as divination or confession. The diagnostic act *is* at the same time a therapeutic one; and that old dichotomy between mental and bodily disease, which we seem largely unable to overcome even with psychosomatic medicine, just does not exist among primitives, either in pathology or in therapy. The whole individual is sick and the whole individual is treated. This particular form of integration offers undoubtedly certain therapeutic advantages, as disease is fundamentally a process of disintegration on

all levels, the physical, mental, and social. Magic or religion seems to satisfy better than any other device a certain eternal psychic or "metaphysical" need of mankind, sick and healthy, for integration and harmony. The non-empirical character of primitive medicine also provides it with an element of certainty which undoubtedly, gives it considerable curative powers.

We are inclined to isolate certain elements of primitive therapeutics, to which I have just alluded, under the label of *psychotherapeutics*. We easily discover in most primitive treatments certain effective mechanisms, which we have applied consciously and on a large scale for a number of years in our own medicine, such as *suggestion and confession*. We have gained a certain understanding of these processes. Through work initiated by men like Pavlov, Cannon, or Freud, we have learned a good deal about the importance of certain mental stimuli for coordination of the whole organism and of the catastrophic physiological consequences of conscious and unconscious fear. In addition, two wars have provided many of us with a certain amount of altogether undesired practical experiences in this respect. It is in the nature of things or, more exactly, it is a consequence of the particular ways in which our sciences and our society have developed that, in no other branch of medicine, do primitive and modern medicine overlap to such an extent as in psychotherapy. We started much later in dealing scientifically with psychological and social problems than with those of matter. The decline of official religion has brought into the office of the doctor many problems which were formerly handled by the priest. A number of years ago Opler published a very interesting analysis of the methods of an Apache medicine man in the light of modern psychotherapy, pointing to parallels as well as to differences. Without denying to modern psychotherapy any of its successes and its merits, I am rather inclined to think that it labors under many delusions as to the degree of rationality it has reached. Many of its cures seem to me due far less to its rationalizations than to the simple mechanisms of suggestion and confession, also underlying certain practices of the medicineman.

We have insisted, above, on the social determinants of primitive medicine; but every consideration of primitive medicine that does not at least try to gain an insight into the biological bases of this medicine, that is, the *pathology* of primitives, would be utterly incomplete.

Everybody who has ever tried to study so-called racial pathology knows that, in no field of primitive medicine, are the data as scanty and contradictory as in this one. Nevertheless, it seems safe to state that truly primitive communities, perhaps because of their relative isolation, of the lower life expectancy of their members, show a relatively low morbidity of their adult population. This has been the impression of qualified observers, not only in the Arctic, Polynesia or North America, but even in such unhealthy regions as South America or Africa.

We must not forget that the same process, which ultimately brought about the development and diffusion of a highly qualified medical science, meant primarily a tremendous increase and spread of disease all over the world. This continent probably knew nothing of measles, smallpox, malaria, yellow fever, cholera, pest, and many other infectious diseases, before its discovery by the white man. Infections were the most deadly automatic weapon of the European in his conquest of the country. It is of historical interest that one of these infections, small pox, on a few occasions, in both North and South America, was used consciously in the warfare against the Indian. It is true that primitive medicine proved, in general, unable to adapt itself to these new situations. Application of traditional methods, like baths in the case of small pox, even had particularly fatal consequences.

Degenerative diseases, which form such an important part of our pathology, had little chance to develop in populations which had an average life expectancy well below 30. Besides frequent accidents and other forms of violent death, this low life expectancy is undoubtedly due to a high infant mortality, which is known and feared, but badly controlled by primitives.

Mental disease, at least in the form of our psychoses, particularly schizophrenia, progressive paresis, or delirium tremens, seem equally rare among primitives. On the other hand, the diseases called "functional" in our terminology often seem particularly frequent. They, together with rheumatism, digestive disorders, colds and respiratory diseases, skin and eye affections, and gynecological disturbances, seem to form the stock-in-trade of primitive pathology. This, and not the post-conquest situation, is the background against which the accomplishments of primitive medicine should be measured. Such a comparison leaves a far more favorable impression of the adequacy of primitive medicine.

I cannot leave my subject without saying at least a few words about the primitive medical practitioner, the *medicine man.* For a long time he has been labeled in anthropological literature, even of the highest caliber, e.g., Tylor, as a fake. I think this point of view has now completely died out and, therefore, need not be insisted upon. We know now that the percentage of fakes among medical practitioners is not higher in primitive than in other societies. We have won a juster appreciation of the so-called tricks of primitive medicine men, that were so highly offensive to early travelers and missionaries, by understanding their symbolical character. It is also interesting to note that less articulate parts of the population have never shared in this contempt for the medicine man. The "Indian Doctor," that is, the native medicine man or an Indian-trained white lay practitioner, was a very widespread phenomenon in frontier settlements throughout the first half of the 19th century, and when Indians were removed to reservations, white settlers petitioned for exception of their Indian Doctor. At early AMA conventions of the 1840's, reports on Indian pharmacopoeia were read. The intensive government-sponsored study of Indian medicine by Hernandez in Mexico and by Piso in Dutch South America, during the 16th Century, belong in the same category.

Another, hardly less complimentary or correct label for the medicine man, that of "psychopath" or "epileptic," still lives in many anthropological textbooks or articles.

I am unable to take up, here, the whole complicated problem of abnormality in primitive society. I refer you to the excellent work of Ruth Benedict, Hallowell, and later writers, which forms one of the most valuable contributions modern anthropology has made to the problems of medicine, psychopathology, and psychology in general. I would, nevertheless, like to stress one technical question which, so far, has been given little attention and which might have played an important role in the genesis of this misunderstanding. Mental disease in primitives, recognized as such by both natives and whites, manifests itself often in so-called states of involuntary possession; that is, paroxysms, accompanied by spastic motions, incoherent language, etc. To the non-initiated, these accidents look like epilepsy, though actually they are not, and fall rather in the group of diseases that we usually call hysteria. Many medicine men, too, are subject to trances and states of possession. Though these forms of possession are voluntary, very

often induced by drugs, perfectly normal and clearly differentiated from the possession-disease by many tribes, to the untrained observer they look very similar to epilepsy or hysteria. I suspect that, through this confusion, the medicine man has undeservedly acquired the title of an epileptic or psychopath.

There is no doubt that psychopathology plays an important role in the life of certain groups of medicine men, the best known of whom is the Siberian shaman. In view of the very special character of the Siberian shaman, it is extremely regrettable that the term, shaman, has been used very loosely as a synonym for medicine men in spite of the protests of Loeb and others. Closer study of the Siberian shaman reveals the perplexing fact that the individual who is to become a shaman passes through a stage of very marked mental disturbance, but that he is more or less cured of this affliction by becoming a shaman.

Even without detailed discussion of the problems of abnormality, it should be fairly obvious that an individual who successfully plays such an important role in society, as the medicine man actually does, cannot, because of mere similarities, be put on the same level as our mentally diseased individuals, whose main characteristic is that they are unable to function successfully in society.

The successes of the medicine man cannot be fully understood, unless one realizes that, acting in small communities, he possesses a more perfect personal knowledge of his patient than most of our doctors do, and that his non-medical activities greatly enhance his authority as a healer.

We hear a great deal about specialists in primitive medicine. It should be realized that this form of specialization seems just the opposite of ours. We have specialists because the volume of our knowledge has become so great that one man can no longer handle all of it. Specialization among primitives seems to result from the fact that there has not yet developed a total body of medical knowledge. One man knows only one or a few spells and practices for one or a few diseases, and thus becomes a specialist for this or that disease.

SECTION OF PHYSICS AND CHEMISTRY

OCTOBER 12 AND 13, 1945

Conference on "*Amino Acid Analysis of Proteins.*"

The Section of Physics and Chemistry held a Conference on "Amino Acid Analysis of Proteins," as the first in the series for the Academic Year 1945–1946. Doctor William H. Stein, Rockefeller Institute for Medical Research, New York, N. Y., was the Conference Chairman, in charge of the meeting.

The program consisted of the following papers:

Introductory Remarks, by William H. Stein.

"The Contribution of the Analytical Chemist to Protein Chemistry," by Hubert Bradford Vickery, The Connecticut Agricultural Experiment Station, New Haven, Connecticut.

"The Use of Specific Precipitants in the Amino Acid Analysis of Proteins," by William H. Stein and Stanford Moore, The Rockefeller Institute for Medical Research, New York, N. Y.

"The Isotope Dilution Method for Amino Acid Analysis," by David Shemin, College of Physicians and Surgeons, Columbia University, New York, N. Y.

"Chromatographic and Ion Exchange Methods in Amino Acid Analysis," by R. Keith Cannan, College of Medicine, New York University, New York, N. Y.

"Microbiological Methods in Amino Acid Analysis," by Esmond E. Snell, College of Agriculture, University of Wisconsin, Madison, Wisconsin.

"Amino Acid Composition of Simple Proteins," by Erwin Brand, College of Physicians and Surgeons, Columbia University, New York, N. Y.

Concluding Remarks, by Hans T. Clarke, College of Physicians and Surgeons, Columbia University, New York, N. Y.

NEW MEMBERS

Elected from May 15 to October 25, 1945

LIFE MEMBER

Wiener, Alexander S., M.D., Medicine, Blood Grouping, Genetics. Serologist, Office of the Chief Medical Examiner; Head, Blood Transfusion Division, Jewish Hospital of Brooklyn; Director, Wiener Laboratories, New York, N. Y.

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Clemens, Carl F., Psychology. Corporal, Chemical Warfare Division, Army Air Forces, South Pacific Theater.

Mendell, Wayne, Psychology, Physics and Chemistry, Meteorology. Vice-President, American Machine and Metals, Inc., Moline, Illinois.

Patterson, Katharine O., Iso-hemagglutinins. In Charge, Serology Department, Reichel Division, Wyeth, Inc., Philadelphia, Pennsylvania.

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